PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

RECD 2 6 MAY 2005

WIPO   PCT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference SLG/43520PCT1	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP 03/03179	International filing date *(day/month/year)* 27.03.2003	Priority date *(day/month/year)* 27.03.2003

International Patent Classification (IPC) or both national classification and IPC

H03M13/41

Applicant

NOKIA CORPORATION et al.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of   sheets.

3. This report contains indications relating to the following items:

I ☒ Basis of the opinion

II ☐ . Priority

III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

IV ☒ Lack of unity of invention

V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

VI ☐ Certain documents cited

VII ☐ Certain defects in the international application

VIII ☐ Certain observations on the international application

Date of submission of the demand 25.10.2004	Date of completion of this report 25.05.2005
Name and mailing address of the International preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Farman, T Telephone No. +49 89 2399-2246

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. **PCT/EP 03/03179**

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)):*

   Description, Pages

   1-13   as originally filed

   Claims, Numbers

   1-25   as originally filed

   Drawings, Sheets

   1/9-9/9   as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☑ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description,   pages:

   ☐ the claims,   Nos.:

   ☐ the drawings,   sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

   ☐ restricted the claims.

   ☐ paid additional fees.

   ☐ paid additional fees under protest.

   ☒ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

   ☐ all parts.

   ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

   | Novelty (N) | Yes: Claims | 3-6,9-12,15-18,21-24 |
   | | No: Claims | 1,2,7,8,13,14,19,20,25 |

   | Inventive step (IS) | Yes: Claims | 3-6,9-12,15-18,21-24 |
   | | No: Claims | |

   | Industrial applicability (IA) | Yes: Claims | 1-25 |
   | | No: Claims | |

2. Citations and explanations

   see separate sheet

General matters

The following prior art is mentioned below:

D1: S. Czaja J. Robertson, "Variable Data Rate Viterbi Decoder With Modified LOVA Algorithm", proceedings on the Region 10 International Conference on Microelectronics and VLSI, 6-10 Nov. 1995. (XP10160164).

D2: E. Boutillon et al., "VLSI Architectures for the MAP Algorithm", IEEE Transactions on Communications, vol. 51, no. 2, Feb. 2003. (XP1164390).

Concerning section IV

1. This Authority considers that there are 2 inventions covered by the claims indicated as follows:

I: Claims 1-3,7-9,13-15,19-21,25 are directed to Viterbi decoding with a first step of calculating path metrics and storing them only at the beginning of sections of a data block and a second step of recalculating the path metrics of a section using the stored path metrics as starting point of the section.

    This invention reduces the size of the path memory.

    Claims 1,2,7,8,13,14,19,20 and 25 do not constitute any invention over the closest prior art (cf. below). They have been searched with this invention and formally included into the first invention.

II: Claims 4-6,10-12,16-18,22-24 are directed to the implementation of a list output Viterbi algorithm (LOVA) in which a second traceback is not performed systematically but only responsive of the presence of an unreliable decision in the path metric memory.

    This invention reduces the amount of processing in a LOVA decoder.

2. The reasons for which the inventions are not so linked as to form a single general

inventive concept, as required by Rule 13.1 PCT, are as follows.

Document D1 discloses a Viterbi decoder having all the features of claim 1, namely:
(1) a path memory (cf. figure 2, "TraceBack RAM") for storing a decision matrix,
(2) path metric processing means (cf. figure 2, "cumulative metric RAM" and ACS
unit) for populating the decision matrix with decision values on the basis of soft
decision bits (cf. Figure 2, upper-right part, "Soft Data In") representing an input
convolutionally encoded data block (cf. page 474, last paragraph, 192-bit frames),
(3) in which the size of the path memory ($13824 = 432 \times 32$ bits) is smaller than the
product ($49152 = 256 \times 192$) of the number of valid states (256 states with constraint
length 9) and the number of input symbols (192) in the data block.

For the sake of completeness, it is noted that claim 1 would lack novelty over most
Viterbi decoders since claim 1 specifies only the normal components of any soft input
Viterbi decoder and an inequation which is normally held since the length of the path
memory is normally designed to be 4 to 6 times the constraint length of the code
(usual values: 2 to 15), which is in most cases much smaller than the size of the data
blocks to be decoded.

Hence, the special technical features of claims 3,9,15 and 21 over prior art D1 are
(a) the storage of path metrics at the beginning of sections of a data block and
(b) the recalculation of path metrics within individual sections starting from the stored
path metrics.

Moreover, the special technical features of claims 4,10,16 and 22 over prior art D1
are
(c) the regeneration of a partial decision matrix including a bad decision and
(d) a traceback operation for tracing the second best path through said partial
decision matrix.

The feature of triggering the regeneration and traceback operations upon detection of
an error does not constitute a special technical feature since it is known from D1, cf.
page 473, second paragraph).

3.   Consequently, the first and second inventions are not linked by their special technical

features and do not contain any common technical features over prior art D1. Hence, the application does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

Concerning section V

1. The present application does not meet the requirements of Article 33 (2) PCT because the subject-matter of claims 1, 2, 7, 8, 13, 14, 19, 20 and 25 is not new over document D1.

a. Document D1 discloses a Viterbi decoder having all the features of **claim 1**, namely:
(1) a path memory (cf. figure 2, "TraceBack RAM") for storing a decision matrix,
(2) path metric processing means (cf. figure 2, "cumulative metric RAM" and ACS unit) for populating the decision matrix with decision values on the basis of soft decision bits (cf. Figure 2, upper-right part, "Soft Data In") representing an input convolutionally encoded data block (cf. page 474, last paragraph, 192-bit frames),
(3) in which the size of the path memory ($13824 = 432 \times 32$ bits) is smaller than the product ($49152 = 256 \times 192$) of the number of valid states (256 states with constraint length 9) and the number of input symbols (192) in the data block.

For the sake of completeness, it is noted that claim 1 would lack novelty over most Viterbi decoders since claim 1 specifies only the normal components of any soft input Viterbi decoder and an inequation which is normally held since the length of the path memory is normally designed to be 4 to 6 times the constraint length of the code (usual values: 2 to 15), which is in most cases much smaller than the size of the data blocks to be decoded.

b. The devices and methods of **claims 7, 13, 19 and 25** contain technical features corresponding to those of claim 1. They lack novelty over document D1 for the same reasons as claim 1.

c. The decoder and decoding methods of **claims 2, 8, 14 and 20** are not novel over the test configuration of D1, page 473, right-hand column, last paragraph, in which the traceback length of 64 is a third of the block size of 192 bits (cf. p. 474, last paragraph).

2.   The subject-matter of **claims 3, 9, 15 and 21** (the "first invention") is considered novel and inventive since none of the available documents discloses or suggests a Viterbi decoder in which a second path metric processing is performed in one trellis section only, which is rendered possible by pre-storage of state metrics at regular intervals in the trellis. The invention allows to reduce the second pass to a section of the trellis without requiring a "learning period" since "seed values" for starting the second pass are available at the beginning of the sections.

3.   The subject-matter of **claims 4-6, 10-12, 16-18, 22-24** (the "second invention") is considered novel and inventive because none of the available prior art documents discloses or suggests a Viterbi decoder in which traceback is performed starting from a bad decision upon detection of an error. In D1, a second traceback is performed starting from the second maximum likelihood path for tracing the second best global path (cf. p. 473, second paragraph), hence not from a bad decision. This invention reduces the portion of the trellis on which traceback is performed in a list output Viterbi decoder.

Further remarks

1.   The two-part form according to Rule 6.3 (b) PCT appears to be appropriate for any independent claim retained. The preambles should be based on document D1 as nearest prior art. It is noted that the features known from D1 appear in the present written opinion in Section V under point 1.a.

2.   Documents D1 and D2 should be referred to in the description as representing the nearest prior art (Rule 5.1 (a) (ii) PCT).